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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

VINH, LAN

ART UNIT PAPER NUMBER

1765

DATE MAILED: 10/14/2003

12

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/800,580

Applicant(s)

SATO ET AL.

Examiner

Lan Vinh

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-111 is/are pending in the application.
- 4a) Of the above claim(s) 53-111 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-52 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☒ Certified copies of the priority documents have been received in Application No. 09/800580.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-5, 9-18, 21-42, 46-52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (US 6,440,295) in view of Stevens et al (US 6,331,490)

Wang discloses a method for forming a semiconductor device. This method comprising the steps of:

forming a trench 125 /interconnection groove in an insulating layer 123 formed on a substrate 124 (col 7, lines 29-34)

forming/stacking a metal layer of copper 121 filling the trench/interconnection groove (col 7, lines 60-66). Fig. 1A of Wang shows that the copper film 121 having uneven surface corresponding to the step difference of the trench/groove on the entire surface of insulation layer 123 to fill trench 125

imposing an electrolyte solution 34 include phosphoric acid/chelating agent between cathode members 1, 2 and wafer 31 having copper formed on the surface, cathodes 1, 2 are electrically charged to have negative electric potential in comparison to wafer 31 (col 8, lines 66-67, col 10, lines 50-55, fig. 7B), which reads on interposing an electrolyte solution comprising a chelating agent between a cathode member and the copper film, the copper film, formed on the wafer, function as an anode

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applying a voltage between the cathode member and the copper film 121 formed on the wafer (col 10, lines 46-50)

selectively removing the projecting portion of copper film 121 corresponding to the uneven surface of the copper film to expose the copper film of the projection portion (col 15, lines 35-42, fig. 1B)

fig. 42 of Wang shows that various power supply output waveforms are repeated for the time periods for the electroplating process, which reads on repeating the film forming step, overpolishing the metal layer 121 to produce flattened copper film surface (col 14, lines 64-65, col 59-61, fig. 1D), which reads on repeating the removing step until the projection portion of the copper film is flattened

Unlike the instant claimed inventions as per claims 1, 23, 25, Wang does not specifically disclose applying a voltage between the cathode and the copper film to oxidize the surface of the copper film by anodic oxidation and form an oxidized copper film/chelating film.

However, Stevens disclose a process for etching a semiconductor wafer comprises the step of specifically exposing the wafer to an electrochemical solution to oxidize the surface of the copper film by anodic oxidation and form an oxidized copper film/chelating film. Stevens also discloses the step of removing the oxidized copper layer (col 11, lines 20-25, col 12, lines 14-17)

Hence, one skilled in the art would have found it obvious to modify Wang's method by oxidizing the surface of the copper film by anodic oxidation and form an oxidized copper film/chelating film as per Stevens because Stevens states that oxidation of copper and

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the subsequent removal of copper oxide from the copper interconnect structure advantageously provides surfaces that can be selectively electroplating with a protective layer (col 12, lines 22-26)

Regarding claims 3, 16, 48, 49, Wang discloses forming a barrier layer of TiN to cover the insulation film (col 7, lines 46-49)

Regarding claim 4, Wang discloses applying a voltage to the anode and cathode of the electroplating solution (col 11, lines 14-18)

Regarding claims 10-11, fig. 7B of Wang shows a polishing tool 30 moves on the surface of the wafer.

Regarding claim 12, Wang discloses using drive 30 to oscillate/vibrate the substrate (col 11, lines 52-54). Regarding claims 14-15, Wang discloses monitoring the current density (col 11, lines 4-13). Regarding claims 21, 22, Wang discloses filling the grooves with copper (fig. 7B). Regarding claim 24, Wang discloses forming a stack of layers comprises of different material on the wafer (col 60-63). Regarding claims 26-29, Wang discloses forming dielectric layer 123 of silicon dioxide and layer 123 can include material having dielectric constant less than silicon dioxide (col 7, lines 13-20). The limitations of claims 30-34 have been discussed above. Regarding claim 36, Wang discloses that the copper ions migrate to the cathode (col 10, lines 19-21). Regarding claims 39-42, Fig. 8 of Wang shows pulse-like voltage has rectangular waveform. Regarding claim 46, Wang discloses that the temperature of the electroplating reservoir is controlled (col 31, lines 41-42). Regarding claim 50, Fig. 1D of Wang shows that metal film 122 outside of the groove is removed.

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3. Claims 6-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (US 6,440,295) in view of Stevens et al (US 6,331,490) and further in view of Liu (US 5,963,040)

Wang as modified by Stevens has been described above. Unlike the instant claimed inventions as per claims 6-7, Wang and Stevens do not disclose using a conductive electroplating plate arranged parallel with the copper film.

However, Liu discloses a method for forming a semiconductor wafer comprises the step of using a conductive electroplating plate 70 arranged parallel with the wafer (fig. 5)

Hence, one skilled in the art would have found it obvious to modify Wang and Stevens by using a conductive electroplating plate arranged parallel with the wafer in the electroplating solution to obtain an uniform distribution of fines particles of a metal (col 5, lines 7-9)

4. Claims 8, 43-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (US 6,440,295) in view of Stevens et al (US 6,331,490) and further in view of Basi (US 3,951,710)

Wang as modified by Stevens has been described above. Unlike the instant claimed inventions as per claims 8, 43-45, Wang and Stevens fail to disclose the step of removing the oxidized copper/chelating film by wiping.

However, Basi, in a method for removing copper contamination, discloses the step of wiping copper metal layer (col 1, lines 24-26)

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Hence, one skilled in the art would have found it obvious to modify Wang and Stevens by adding the step of removing the oxidized copper/chelating film by wiping as per Basi because Basi teaches that the continuous wiping of the silicon substrate removes the copper from the substrate and produce an extremely flat and well-polished surface on the silicon (col 1, lines 30-34)

5. Claims 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (US 6,440,295) in view of Stevens et al (US 6,331,490) and further in view of Degani (US 5,904, 859)

Wang as modified by Stevens has been described above. Wang and Stevens differ from the instant claimed invention as per claims 19-20 by using phosphoric as chelating agent instead of citric acid.

However, Degani, in a method for forming semiconductor device, teaches that citric acid, phosphoric acid can be used as chelating agent (col 5, lines 26-32)

Thus, one skilled in the art would have found it obvious to substitute Wang and Stevens phosphoric acid with citric acid in view of Degani teaching because both acids are chelating agents, thus, the substitution of one for the other would have produced an expected result.

Response to Arguments

5. Applicant's arguments with respect to claims 1-51 have been considered but are moot in view of the new ground(s) of rejection.

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Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302.

The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 703 305-2667. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308-0661.



LV
September 29, 2003